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ERP Selection: The SMART Way

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Abstract

Enterprise resource planning (ERP) systems implementation projects are challenging and resource consuming. There are several phases in the ERP implementation process. One of the earliest and most critical phases is the ERP selection phase. If an organization selects an inadequate ERP to fit their needs, the project will most likely destine to fail. Research and practice have provided several cases of ERP project failures because of a faulty selection process. No matter what amendments the adopting company undertakes in the later phases, if there is no fit, there is no success. This research, presents an explanatory case study, which employed a simple multi-attribute rating technique (SMART)-based ERP selection method. The selection method was mainly based on developing process maps for all the critical business processes inside the organization, and then checking the degree of compliance of the potential ERP packages with those developed process maps. In addition, other factors were also included in the ERP evaluation and selection process. As the ERP was assured to be matching the business requirements, the method and the selection factors have been proven adequate for the selection process. In addition, this minimizes the risk of a non-fitting ERP system and consequent project failures.

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Keywords: ERP selection; SMART; explanatory case study.

1. Introduction

Enterprise resource planning (ERP) systems are large and comprehensive packaged information systems (IS) aimed at integrating business processes and functions. ERP system evolved from material requirements planning (MRP) and manufacturing resource planning systems. They cover the traditional business functions within organizations, including finance, accounting, sales, human resources, and procurement. ERP systems also enable

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companies to efficiently and effectively manage and utilize their resources (materials, human resources, finance, etc.) through providing a total and integrated solution for the organization's information-processing needs [1]. They support a process-oriented view of the business as well as business processes standardization across the enterprise. Among the most important features of an ERP, is its ability to automate and integrate an organization's data and business processes across the entire enterprise in a real-time environment. ERP systems are offered as packaged solutions with long complicated interrelated code containing standard processes. These pieces of codes have been usually adapted and enhanced over a long period of years, like for example in the SAP ERP packages. Usually businesses have their own existing competitive advantage processes set in place, however, several businesses change their non-standard processes to fit the software in order to take advantage of future updates, benefit from the best-practice processes, and avoid costly irretrievable errors [2, 3].

In the past decade, the emergence of ERP systems is considered one of the most important IT-enabled business innovations [4]. A study conducted by AMR Research on mid-size to large companies; found that 67% of these organizations are implementing some form of ERP, while another 21% are evaluating potential ERP systems solutions. As an increasing number of organizations are adopting ERP systems, ERP systems implementation and upgrades are identified as one of the top five IT priorities among global CIOs according to an independent surveys conducted by Morgan Stanley and Deloitte & Touche/IDG Research Services Group. Organizations worldwide remain allocating a substantial portion of their IT budgets towards either completion of their initial ERP system installations or upgrades to their existing systems.

ERP systems are typically implemented as projects and in phases. ERP implementation projects regularly involve the adoption decision, selection of ERP package and vendor, implementation, use and maintenance, and evolution [5]. ERP implementation projects normally involve internal IT & key business personnel from inside the organization, as well as, external consultants, or consultants from implementation partners in order to be successful. This shows how resource consuming and expensive ERP projects are [6]. A successful ERP adoption project involves the selection of the appropriate ERP system and a competent vendor, the actual installation of the system, managing organization and business processes change, and examining the compatibility of the system. However, a wrong ERP system selection would either fail the project or critically dwindle the system and hurdles the company performance [6, 7]. ERP selection is a difficult and time-consuming task. This is mainly due to the scarcity of available resources, complexity of the ERP packages, and the diverse ERP system alternatives in the market [8]. In practice, the ERP selection process involves several factors. One of the paramount factors is the functional fitness of the system with the business requirements [8]. Finally, ERP literature suggested several critical ERP selection factors, but very few studies have tested their applicability in real-life context.

Although the ERP adoption process has several phases, however, this paper focuses-on and discusses the ERP selection process. This study offers an in-depth explanatory case study conducted in an Egyptian manufacturing enterprise. The remainder of the paper is organized as follows: section 2 presents the related literature, followed by the research methodology and case description in section 3. Section 4 illustrates the research analysis, and finally the research conclusions are presented in section 5.

2. Related Work

ERP is a standard software package that provides integrated transaction processing and access to information for the multiple organizational units and multiple business functions. These functions include financial and accounting, human resources, supply chain, and customer services. The standard in-house ERP system is based on a central database. This database gathers data from the various business functions. The database also feeds the data into modular applications supporting virtually all of the company's business activities – across functions, across business units. When new data is entered at one corner of the organization, related data in other units is then accordingly updated. Most companies expect ERP to reduce their operating costs, increase process efficiency, improve customer responsiveness and provide integrated decision information [9]. They also seek to standardize processes and learn the best practices embedded in ERP systems to ensure quality and predictability in their global business interests by reducing cycle times from order to delivery [1].

When organizations adopt ERP systems, they face several challenges. Some of those challenges are related to the degree of business process re-engineering (BPR) needed to accommodate the new system. In addition, customization and change management are also considered critical challenges during the project. On the other hand, in some cases, organizations are inclined to adopt a

vanilla implementation, which could be the least risky implementation approach [10]. In a nutshell, vanilla implementations dramatically minimize the degree of BPR; they follow core ERP functionalities and process models instead of customizing the ERP package to fit the enterprise's unique processes [11]. All ERP implementation approaches require careful project management activities and a committed team. After the implementation, organizations usually suffer a "shakedown" phase, during which they face challenges at the same time as they have to adapt to the newly introduced and re-engineered processes [12]. This might result in operational disruptions or reduced productivity for a certain period of time. Studying the capabilities of the potential ERP system to accommodate the critical business processes of organizations is the first step in insuring a successful ERP selection. Literature has provided cases of early ERP retirement and project cancellations because of a wrong selection due to the "no fit" between the system and the unique business processes [13]. In their study, Haddara & Elragal [6] recommended that organization should not overlook formal ERP selection practices, and stressed on user engagement, as this could lead to ERP failures and wrong system evaluations. In addition, they have advocated for business process requirements mapping with the potential system's technical capabilities prior to the acquisition decision [6,13].

Organization-specific characteristics and contexts have been also important research aspects throughout, prompting researchers to investigate their implications on the ERP implementation process. The majority of literature acknowledges the organization size as a critical factor for ERP implementation success [14]. Instead, other factors like "ERP size" could also be a critical factor because of its influence on businesses and implementation complexity. The fit between the strategic business goals and ERP objectives is similarly considered as an important factor for creating business benefit from the ERP adoption project [10]. According to Elragal & Al-Serafi [10], ERP systems are not difficult to implement, yet users must specify which goals to attain with the new system, how the functionality of the system can achieve this, and how to configure, customize and technically implement the package.

In order to better understand and evaluate the selection and acquisition process, several studies identified the factors that affect ERP selection in organizations, and proposed criteria to optimize the selection process. For example, [15] has developed a framework for ERP selection, presented in figure 1. The framework starts with the adopting company's business goals and vision, followed by analysing the business requirements and constraints (e.g. technical, financial), and finally the package and vendor selection.

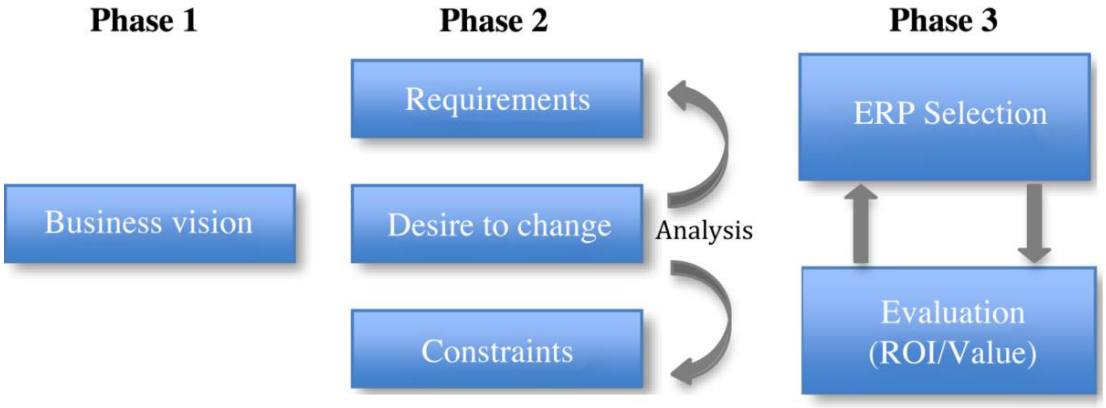

Fig. 1. ERP selection framework. Adapted from [15]

Other research results suggest that a number of organization-related factors like business process complexity, change management, and external factors like supply chain partners and value networks pressure affects the ERP selection process in Greek small and medium size enterprises (SMEs) [16]. While other research conducted in Australian firms, suggests that business requirements, system flexibility, cost drivers, and scalability of the ERP system [17], and the degree of ERP alignment/fit with the business processes [18] have a great influence on the ERP selection decisions. In [19], they stated that the ERP fit with organization business processes appeared to be the most important selection criterion in Nordic-European SMEs, whilst others developed dimensions that could aid organizations in the selection process. The dimensions were local support, cost, suppliers' business domain knowledge [20]. In addition, CEOs' technology awareness, employees' IT competence, firm size, ERP compatibility [21, 22], and project management [23], were identified among the critical success factors (CSF) for selecting the right ERP for SMEs. In their review of ERP implementations risks, [7]

stressed on the importance of fitness between the organizational business process requirements and the ERP functionalities and capabilities. They have classified the ERP selection process as the top cited risk factors in ERP literature, as well as, the inadequate ERP package selection as being the paramount risk factor in ERP implementations (see table.1). They also have suggested that a wrong package selection is a key concern and could lead to time, cost, and risk escalations, which eventually could lead to drastic circumstances that can eventually lead to total project failures [7]. In addition, they have advocated for a structured multi-criteria approach for evaluation the ERP system and vendor. The criteria include functionality, technology, support, and costs.

Table 1. Risk factors frequency in ERP literature. Adapted from [7].

Risk factor	Frequency rate
Inadequate ERP selection	High
Poor project team skills	Medium
Low top management involvement	Medium
Ineffective communication system	Medium
Low key user involvement	Medium
Inadequate training and instruction	Medium
Complex architecture and high number of modules	Low
Inadequate BPR	Medium
Bad managerial conduction	Medium
Inadequate financial management	Low
Inadequate change management	Medium
Inadequate legacy system management	Low
Inadequate IT supplier stability and performance	Low

A multiple case study showed that the weighted scoring SMART (simple multi-attribute rating technique) analysis is widely used as an ERP selection technique in Egyptian SMEs [24]. In addition, the paper suggested that the feedback from the vendor's references was one of the top factors in ERP selection in their target cases. Although it is easy to apply and widely used [25], however, the SMART analysis' effectiveness varies between organizations depending on the factors and weights they identify and include in the analysis.

Due to limitations in available resources and expertise, the high complexity of ERP systems, and the diversity of selection criteria, selecting the proper ERP system is not a trivial task.

3. Research methodology and target case

Qualitative research approach is normally used where knowledge about the problem domain is rare and rather unstructured [26]. Thus, an in-depth explanatory case study was chosen and qualitative methods were employed in this research. Explanatory case study research is useful to represent cases when exploring new phenomena or when there is a lack of theory. According to Yin [26], explanatory case study research method is recommended when "how" and "why" questions are postured, when the researcher has little control on the events, and when the focus of the investigator is on a current phenomenon that occurs in a real-life context. In general, case studies can include the analyses of persons, events, decisions, periods, projects, institutions, or any other systems that are investigated and studied holistically through one or more research methods [27].

Generalizability and transferability from qualitative research and case studies may pose something of a challenge. The relatively small samples available mean that it is difficult to replicate findings in other contexts [28]. Nonetheless, several researchers argue that it is feasible to generalize and develop theories from such case studies [29,30]. Guba & Lincoln [31] argue that 'thick descriptions' of case studies could help other researchers in judging the transferability of their descriptions to their own contexts and lexicons. This would allow the collection of rich descriptive data on the ERP selection phase in a manufacturing SME in its natural setting. The purpose of this study is thus to increase our knowledge of the factors which

lead to a successful and systematic ERP selection decision. Although single case studies' generalizability is limited, however, it can provide important insights and directions for future research.

3.1. Data Collection

This research was carried out as a single in-depth explanatory case study [32]. Several qualitative face-to-face and semi-structured interviews were conducted. The interviews were carried out in one Egyptian manufacturing SME and were mainly focused on the ERP system selection process as well as business processes. The interviews ranged from 30 to 60 minutes, and notes were taken during the interviews. The participants included a mixture of stakeholders who have been involved in the ERP system selection and evaluation. The interviewees' positions included the general manager, IT Manager, business function managers, mid-level, and the external ERP selection consultant. The variety of interviewees engendered different perspectives which enriched the data collected through data triangulation [28], and the analysis consequently.

In general, a convenient access to all the resources needed for the successful completion of this research was granted. In addition the author had access to the selection criteria and the final selection report submitted by the ERP consultant who assisted ABC Company in the selection process. In addition, the author had access to the data used for the comparison of the ERP packages, project documentation, internal organizational documents, company profile, vendors' websites, and emails related to the selection process. During the selection process, the consultant has asked all the employees to fill in a "business process form" in which they describe all the business processes they conduct in their day-to-day operations. Then the consultant compiled and modeled all of this information as business process maps (e.g. fig 2), which the author also had access to.

3.2. The ABC Company

The Company is an Egyptian strategic business unit (SBU) of a larger company. The ABC Company is a manufacturer of oil derivatives that are used as raw materials in several industries. The company's headquarters is located in Europe. The mother company has been in business for more than sixty years and is listed in the New York Stock Exchange. It has nine SBUs that virtually cover the world. The company name has been disguised for anonymity. The ABC Company has 23 employees. Given the separate operations, financial, scale, and market size of the Egyptian SBU, the ABC Company has been regarded and categorized as an SME, and a small enterprise in particular. The ERP selection process started in January 2014 and was completed in April 2014. The selection process has been conducted by an external ERP consultant, which was brought into the project to aid ABC Company in their ERP evaluation and selection process.

The mother company has an SAP ERP All in One installed at its premises. When the consultant was asked to join the ERP adoption project team, he inquired about the possibility of just creating accounts for the Egyptian SBU's users on the main ERP system at the headquarters. It turned out to be not applicable due to the European laws regarding data ownership and transfer. The Egyptian ABC Company has already decided on adopting an SAP ERP for ease of yearly reporting and interoperability, and also the headquarters has recommended this, as the ERP has proven matching in their respective industry. A previous consultant, who worked briefly on the project before the current consultant, suggested implementing an SAP All in One ERP like the headquarters. With the great difference in implementation complexity, target organization size, and costs between SAP's All in One and the other SAP ERP packages, the current ERP consultant decided that the selection decision should be based on business requirements, processes, organization size, and other factors. Initially, there were three SAP ERP system candidates in the evaluation process, SAP All-in-One (A1) and SAP Business-one (B1), and SAP ByDesign (BYD). However, based on a decision by the ABC Company, two SAP ERP systems only have been short-listed for selection. The systems were SAP A1 and SAP B1. The third system from SAP BYD was eliminated form the comparison, as it is only available on-demand and it was communicated to the consultant that the on-demand option might not be acceptable as a solution by the headquarters. Additionally, SAP B1 is available on both: premise as well as on-demand.

In the next section, details about the ERP selection criteria and comparisons between SAP A1 and B1 ERPs are discussed.

4. Analysis

Selecting the compliant ERP solution that best fits with the company's information needs and procedures is a very

important and critical process. On the contrary, the incorrect selection of an ERP system that is not able to match the organization strategic goals is a risky pitfall. Software and hardware aspects are also very important dimensions and characteristics to be included in the appropriate ERP system evaluation and selection. The criteria for the selection and package comparison at ABC has been set after the consultant met with the ABC Company top management and key users. The selection criteria was not directly dictated, instead, it was inferred in part and suggested in part.

The selection process mainly employed a process mapping method, and adopted a structured multi-criteria evaluation that has been developed through literature and the consultant's practical experience in the field. Beside the organization's size and specific contextual dimensions, the evaluation and assessment factors mainly included 11 factors: functionality of the ERP system - business process mappings with the ERP package, technical criteria, cost & budget, service and support, vision, systems reliability, compatibility, market position, modularity and integration, implementation methodology, and the ERP package fitness with the organization size and context. The abovementioned factors are discussed in more details below in relation to the shortlisted SAP A1 and B1 systems.

- The first criterion considered is the ***functionality of the ERP system***. Functionality is said to be the most essential evaluation factor. This factor should usually carry a heavy weight in the whole decision evaluation procedure. The first aspect in the functionality is called completeness or comprehensiveness. Completeness means that the ERP solution should have adequate or even more modules related to the organization main activities, and supports the critical business processes.

A1	Both systems have the ability to manage core business operations *(Sales-Purchasing-Accounting)*.
B1	Additionally, and according to SAP, both A1 and B1 are able to support virtually ALL industries [33].

During this evaluation criterion, the consultant has developed the business process maps (e.g. fig. 2) that were compiled from the business process profiles created by the ABC Company's employees. The process maps were then compared against the candidate systems' business process maps. This was a critical criterion, as it was a yes/no evaluation factor. This means that if the required business requirements were not matched by a system, the system will be directly excluded from the candidacy.

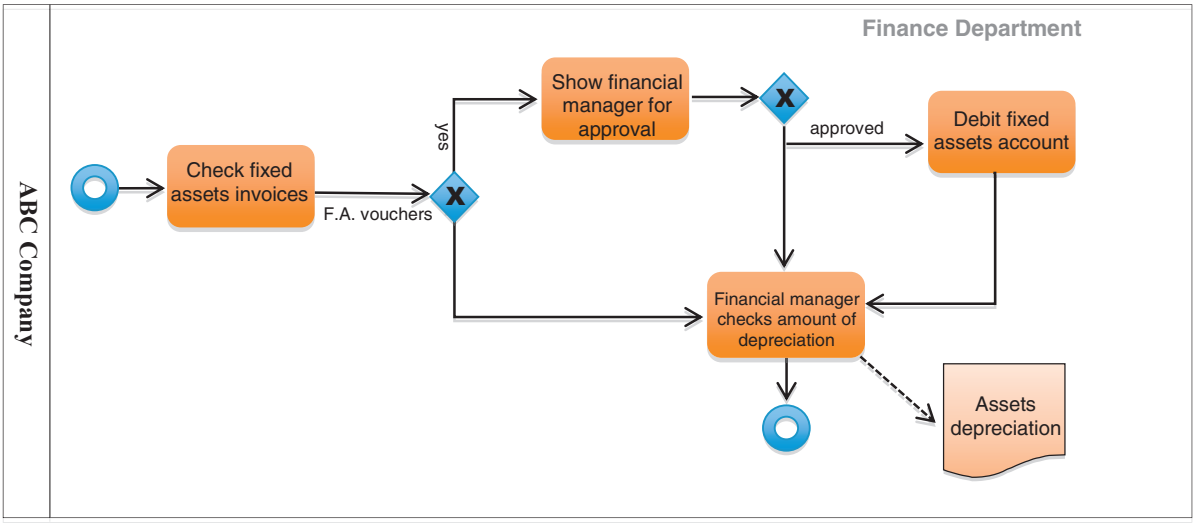

Fig. 2. Process map sample: fixed assets depreciation

Both systems were proven to be accommodating and compliant with ABC Company's business processes. Thus, both systems advanced through the remaining selection and evaluation process.

- The second criterion is the ***technical criteria***. The selection of the hardware and the software is of a huge importance concerning the approval of an ERP solution. Preferably, the system should accommodate the current

new trends in the IT industry. Organizations should be certain that the vendors would provide upgrades and security updates to the ERP products to ensure best utility of technologies that are more likely to exist in the future. It is very essential for organizations to use internal knowledgeable staff or external consulting group to assess and evaluate the ERP system's technical features. Technical criteria would also reveal another aspect, which is the easiness of using the software, the stability, the quality, and all other technical aspects.

A1	Requires more complicated as well as a higher IT footprint. A1 could only be offered on-premise. Requires NetWeaver.
B1	Requires simple IT footprint. B1 could be offered on-premise and on-demand. Does not require NetWeaver.

- The third criterion considered is the ***cost & budget***. The company should know very well if it could afford to buy and implement the ERP system. This issue is very essential and critical in the selection process. Research shows that the majority of the ERP implementations worldwide cross their budgets [3]. Although the ERP solution should have an attractive price, however, putting realistic expectations for the whole implementation budget is very important. The cost of adopting an ERP is not only about the ERP package, it contains many other cost factors including the hardware, the software, consulting, training, organization change management (OCM), etc.

A1	Requires a substantial budget (IT footprint; annual license; SAP User; Personnel), as well as, a higher total cost of ownership (TCO). A1 requires a team of: Database Administrator (DBA); Basis Consultant; as well as Functional Consultants (*at least 3 consultants*). The starter package of 5 users ($5000) + 1 developer ($9000) + 1 professional ($5000) + 22% annual maintenance *(total cost of USD 45,000; rough before partner discounts),* excluding H/W costs.
B1	By far requires smaller budget (IT footprint; annual license; SAP User; Personnel) as well as less TCO. One of the key strength here is that, B1 requires only 1 person to manage and support. As for the costs, B1 starter package could go as minimum as 1 user and up to 5 users *(Total cost of $7,000 in USA)*. Reusable budget when upgrading to full-fledge B1.

- Another criterion is the ***service and support*** and this is paramount because the fitting and installation costs can reach seven to ten times the preliminary software cost. The service and support linked with the application is with highly importance to the success of the corporation between the organization and the vendor. The majority of organizations face technical problems with the application during installation, execution, or after the execution period. Integration with the current available systems, customization, and security measures are the most severe problems for organizations. For handling theses difficulties, organizations require maintainability and support from suppliers both in provision of information technology expertise and field knowledge.

A1	Both systems would not be different as they are supplied from the same vendor (SAP) which manages the upgrades, fixes, as well as Enhanced Packages (EHP). To avoid the complexity of full system upgrades, and the gap between the current version at the organization and the new released version from SAP, SAP releases EHP with minimal updates that include only the main new features.
B1	

- The vision criterion is an essential criterion. In the ***supplier evaluation*** procedure, criteria like the supplier strength and status should also be considered. Organizations should think about the vendor's vision. The enhancement of the vendors' product and services are also important and how the supplier will plan for this enhancement. The vision would also reveal the supplier's business image and the international current status, as well as, its background and history.

A1	Both systems come from the same vendor; SAP. But as a matter of fact, SAP has more than 80% of their revenue coming from SME market. The same business segment to which ABC Company belongs.
B1	

- Another important criterion is the ***system reliability***. This is actually sometimes considered to be the second essential criterion in ERP selection. In general, system reliability means that they system is mature and performs according to specifications. SAP ERP is considered one of the most mature ERP systems in the market. In addition, having a strong vendor, which is considered to be a market leader in this type of business, is sometimes advantageous to the organization. Adopting organizations usually gather information about the potential ERP system and vendor. This information could for example be to know how many years the ERP supplier has been working with the core of ERP business solutions, other information could also be like, if the available current clients with the supplier considered to be satisfied customers.

A1	Both systems come from the same vendor; SAP. With higher rates of successful ERP implementations (*A1 and B1*), the system reliability score of both systems scores high rations to secure ABC Company's future business. Till 2011 SAP B1 has more than 39,000 customers worldwide; 120+ countries; and includes Arabic support.
B1	

- ***Compatibility*** is considered to be another essential criterion. Compatibility means compatibility and interoperability with other systems. There is no one application that can conduct everything the organization requires. The chosen ERP solution must be linked with all the internally grown systems as well as the unique software or products that the organization may be using to accomplish specialized requirements. From this perspective, compatibility or integration with other systems is considered to be a crucial criterion for selecting the ERP solution.

A1	A1 is 100% compatible with Headquarters in Europe who also runs the same system (*SAP ERP A1*).
B1	B1 is fully integrated with A1 out of the box based on its powerful integration framework. Various scenarios for integration are available, e.g., Business Suite-to-B1 or NetWeaver-to-B1 for master data, sales, purchasing, HQ reporting, and finance.

- The ***market position*** of the supplier is another important criterion. A lot of organizations rely highly on vendor reputation, status, as well as, service infrastructure when choosing the ERP solution. World's leading ERP suppliers have been mostly conducting the best global practices with their ERP products. From this perspective, organizations frequently look at the ERP vendors as process helpers or advisors. Specifically, the finished successful ERP projects in the same type of business or industry of the adopting organization can be considered as a vital criterion for the selection process of the ERP system. Thus, the ABC company should choose the ERP supplier based on the industry experience.

A1	Both systems come from the world's leader, SAP, in ERP. Thus, they have the best market position.
B1	

- Another very important criterion is the system's ***modularity and integration***. The ideal ERP system should have its modules integrated with one another, and be module-independent, where organizations are free to choose the modules they need only.

A1	- Indeed all A1 modules are fully integrated. - Customer relationship management (CRM) functionalities require a different license/product. - Has mobile application, which is ready and free out of the box to have access from iPhone and iPad. - Can run on Oracle, MS SQL Server, IBM RDBMS. - Can run on SAP HANA (*same like B1*).
B1	- Indeed, as well, all B1 modules are fully integrated. - B1 comes with both CRM as well as data warehouse management (WHM) functionality included. It should also be clear that there is no independent CRM product, instead, the CRM functionality has been integrated into the sales and marketing module/functionality. - Also, has mobile application, which is ready and free out of the box to have access from iPhone and iPad. - Can run on MS SQL Server RDBMS (does not run on Oracle DBMS). - Can run on SAP HANA (*same like A1*).

- A rather important criterion is the deployment of a solid ***implementation methodology*** while running the project. The presence of a reliable, tested, and consistent methodology would enhance the success ratio. In each phase of the methodology, a plan of activities should be clearly defined, whom to carry them, their inputs, outputs, milestones, etc.

A1	As a matter of fact, both systems follow the same implementation methodology from SAP. That is, the "ASAP". The ASAP implementation methodology consists of five phases: project preparation; business blueprinting; project realization; final preparation; go-live and support. But, according to SAP (30), implementation time takes 2-4 weeks with B1 whilst 8-16 weeks with A1 *(90% of the time, there exist a time overrun).*
B1	

- Finally, ***ERP package fitness with the organization*** size was evaluated. As the ABC Company is categorized as a small enterprise, SAP B1 was a good match to the organization size. That is also confirmed by SAP [33] as presented in figure 3.

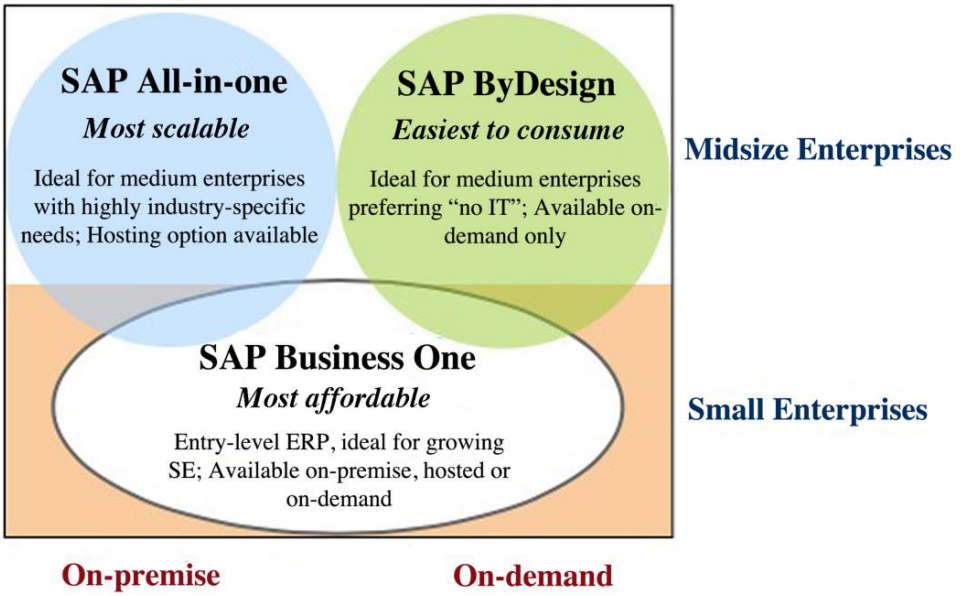

Fig.3. SAP ERP Business solutions to SMEs

The two SAP ERP systems have been evaluated against the selection criteria factors. In the end, SAP B1 has been recommended for implementation at the ABC Company as on-premise rather than on-demand solution. This is fundamentally due to restrictions on in-cloud e.g., customization and integration. As a matter of fact, both SAP ERP systems are able to meet the requirements of ABC Company; able to integrate with HQ's ERP system; but B1 is significantly less in TCO and implementation complexity.

5. Conclusions

A large variety of ERP systems and supporting services are being offered by established ERP vendors and their implementation partners. The decision to acquire an ERP system is becoming increasingly complex in such a changing and competitive environment. Enterprises pursuing systems integration should select systems that contribute to this goal, of course, without sacrificing the functionality of applications they believe are crucial for their business. Careful selection of vendors, products, and services provided is necessary, but the final decision has to be made considering the amount of organizational change required for the implementation of the selected ERP system. In this paper, an ERP selection case study has been presented in details. Although ERP literature presented several important SMART selection criteria, however, few studies presented their actual application in real-life cases. This study illustrated the ERP selection process and techniques applied at the ABC Company. The selection process followed the SMART in an innovative manner. That is, 11 criteria factors have been devised and later applied to score the different ERP systems. This has widened the

selection scope and ensured to take each and every concern to the limit. The selection criteria included business process mappings, packages comparisons, among other dimensions.

Finally, the selection and recommendation report was submitted by the ERP consultant to the ABC Company's top management, and mother company. The report was approved and the company progressed in the acquisition of the chosen SAP B1 package.

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